Mark Scheme 4729
January 2007

1		com directly above lowest point	B1			
		tan α = 6/10	M1			
		α = 31.0	A1	3	or 0.540 rads	**3**

2		e = 1 = (*y*–*x*)/4	B1		or ½x0.2x^2 + ½x0.1y^2 =	
		0.8 = 0.2*x* + 0.1*y*	B1		½x0.2x4^2(B1/B1 for any 2)	
		solving sim. equ.	M1		not if poor quad. soln.	
		x = 4/3 only	A1	4		**4**

3	(i)	$x^2 = 21^2$ + 2x40x9.8	M1			
		x = 35	A1			
		$0 = y^2$ – 2x40x9.8	M1			
		y = 28	A1		may be implied	
		e = 28/35	M1			
		e = 0.8	A1	6	aef	
	(ii)	0.2x28 – – 0.2x35	M1		must be double negative	
		I = 12.6	A1	2		**8**

4	(i)	½x80x5^2 or ½x80x2^2 either KE	B1		1000/160	
		70 x 25	B1		1750	
		80x9.8x25sin20°	B1		6703.6	
		WD=½x80x5^2-½x80x2^2+70x25+80x9.8x25sin20°	M1		4 parts	
		9290	A1	5		
	(ii)	Pcos30°x25	B1		or a=0.42	
		Pcos30°.25=9290 / Pcos30°-70-80x9.8sin20°=80a	M1			
		P = 429 /if P found 1st then Pcos30°x25 =9290 ok	A1	3		**8**

5	(i)	D = 3000/5^2 = 120	M1			
			A1	2	**AG**	
	(ii)	120 – 75 = 100a	M1			
		a = 0.45 ms^{-2}	A1	2		
	(iii)	100x9.8x1/98	B1		weight component	
		3000/v^2=3v^2+100x9.8x1/98	M1			
		3000 = 3v^4 + 10v^2	A1		aef	
		solving quad in v^2	M1		(v^2 = 30)	
		v = 5.48 ms^{-1}	A1	5	accept √30	**9**

6	(i)	com of Δ 4 cm right of *C*	B1			
		1.5 x 10 + 7 x 20 = $\bar{x}$ x 30	M1			
			A1			
		$\bar{x}$ = 5.17	A1		5 1/6 31/6	
		com of Δ 6 cm above *E*	B1		or 3 cm below *C*	
		4.5 x 10 + 6 x 20 = $\bar{y}$ x 30	M1			
			A1			
		$\bar{y}$ = 5.5	A1	8		
	(ii)	tanθ = 5.17/3.5	M1		right way up and (9─ $\bar{y}$)	
		55.9° or 124°	A1√	2	√ their $\bar{x}$ /(9 – $\bar{y}$)	
	(iii)	d = 15sin45° (10.61)	B1		dist to line of action of T	
		Td = 30 x 5.17	M1		allow Tx15 i.e. T vertical	
		T = 14.6	A1	3		**13**

7	(i)	$T\sin30°$	B1			
		$T\sin30° = 0.3x0.4x2^2$	M1		resolving horizontally	
			A1			
		$T = 0.96$	A1	4		
	(ii)	$R + T\cos30° = 0.3x9.8$	M1		resolving vertically	
			A1			
		$R = 2.11$	A1√	3	√ their T (2.94–Tcos30°)	
	(iii)	$T_1\sin30° = 0.3 \times v^2/0.4$	M1		or $0.3x0.4x\omega^2$	
			A1		$(T_1 = 1.5v^2)$	
		$T_1\cos30° = 0.3 \times 9.8$	B1		$(T_1 = 1.96\sqrt{3} = 3.3948)$	
		$R = 0$	B1		may be implied or stated	
		$\tan30°=v^2/(0.4 \times 9.8)$for elim of T_1	M1		and $v=0.4\omega$ ($\omega = 3.76$)	
		$v = 1.50$	A1	6		**13**

8	(i)	$v_v = 42\sin30°$ (=21)	B1			
		$0 = 21^2 – 2x9.8xh$	M1			
		$h = 22.5$	A1	3		
	(ii)	$v_h = 42\cos30°$ (=36.4)	B1			
		$v_v = \pm v_h \times \tan10°$	M1			
		$v_v = \pm6.41$ or $21\sqrt{3}\tan10°$	A1		or $42\cos30°.\tan10°$	
		$–6.41 = 42\sin30° – 9.8t$	M1	**	must be –6.41(also see "or" x 2)	
		$t = 2.80$	A1	**		
		$y=42\sin30°x2.8 – 4.9x2.8^2$	M1	**		
		$y = 20.4$	A1√	**	√ their t	
		$x = 42\cos30° \times 2.80$	M1			
		$x = 102$	A1√		√ their t	
		$\sqrt{(x^2 + y^2)}$	M1			
		$d = 104$	A1	11		
	or	$6.41^2 = 21^2 + 2 \times -9.8s$	M1	**	vert dist first then time	
		s = 20.4	A1	**		
		$20.4 = 21t + ½. -9.8t^2$	M1	**		
		$t = 2.80$	A1	**		
	or	22.5 – s and $6.41^2=2x9.8s$	M1	**	dist from top (s = 2.096)	
		y = 20.4	A1	**		
		22.5 & $2.1 = ½.9.8t^2$	M1	**	2 separate times (2.143, 0.654)	
		$t = 2.80$	A1	**	2.143 + 0.654	**14**
		alternatively				
	(ii)	$y = x/\sqrt{3} – x^2/270$ aef	B1		$y=x\tan30°– 9.8x^2/2.42^2.\cos^230°$	
		$dy/dx = 1/\sqrt{3} – x/135$	M1		for differentiating	
			A1		aef	
		$dy/dx = – \tan10°$	M1		must be $–\tan10°$	
		$1/\sqrt{3} – x/135 = – \tan10°$	A1			
		solve for x	M1			
		$x = 102$	A1√		√ on their dy/dx	
		$y = x/\sqrt{3} – x^2/270$	M1			
		$y = 20.4$	A1√		√ their x	
		$\sqrt{(x^2 + y^2)}$	M1			
		$d = 104$	A1	(11)		